Implementation Convention (IC) 1 for Unmanned System Interoperability Profile (USIP) 1 For Line of Sight Transmission of Motion Imagery for Battle Space Awareness using Standard Common Data Link

1. SCOPE

1.1 CAPABILITY DESCRIPTION

This IC addresses the Joint Capabilities Area (JCA) for Battle Space Awareness. Battle Space Awareness is the knowledge and understanding of the environment, factors, and conditions of the environment of an operational area, including the status of friendly and adversary forces, neutrals and noncombatants and weather and terrain, to enable timely, relevant, comprehensive and accurate assessments, in order to successfully apply combat power, protect the force and complete the mission.

A Situational Awareness (SA) Product is a concise, transportable summary of the state of friendly and enemy elements conveyed through information such as Full-Motion Video (FMV), imagery, or other data that can contribute to the development of Situational Awareness either locally or at some distant node. Such products provide the Situational Awareness that enables the human perception of the elements of the operational environment in the context of forces, space and time, the comprehension of their meaning, and the projection of their status in the near future.

Motion Imagery is defined as imagery [a likeness or representation of any natural or man-made feature or related object or activity] utilizing sequential or continuous streams of images that enable observation of the dynamic, (temporal), behavior of objects within the scene. Motion Imagery temporal rates, nominally expressed in frames per second, must be sufficient to characterize the desired dynamic phenomena. Motion Imagery is defined as nominally beginning at frame rates of 1 Hz (1 frame per second) or higher within a common field of regard. FMV is motion imagery.

This IC addresses the interoperability of imagery from an unmanned system's sensor to a ground control station or remote video terminal. Currently, the Geospatial Intelligence exploitation of that motion imagery is performed on an individual frame using MIL-STD-2500C (National Imagery Transmission Format, Version 2.1) and a frame capture tool. It is almost universally true that metadata is included asynchronously, that is, metadata are generated at differing rates and not all metadata are attached to every frame. The lack of consistent data elements can create serious interoperability issues. For that reason, the UAS Task Force will create an Implementation Convention to address this issue and address the applicable standards necessary for dissemination of the data such as through the Distributed Common Ground System (DCGS) to promote interoperability of the data across the National System for Geospatial-Intelligence (NSG).

1.2 Concept of Operations (CONOPS) LINK

The Joint Concept of Operations for Unmanned Aircraft Systems, First Edition, March 2007, identifies situational awareness as a desired effect in all three phases of Major Combat Operations.

2. APPLICABLE STANDARDS

The following list identifies the mandatory UAS standards and related specification and technical documents for this IC. These documents must be included in the UAS Integrated Architecture Technical

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View 1, developed in accordance with the Department of Defense Architecture Framework guidance. In the event of a conflict between the text of this IC and the references cited herein, this specification takes precedence. Nothing in this IC supersedes applicable laws and regulations, unless a specific exemption has been obtained.

- Motion Imagery Standards Profile (MISP 4.4), 13 December 2007
- MISB Engineering Guideline EG 0601.1, UAS Data link Local Metadata Set, 13 December, 2007
- MISB Engineering Guideline EG 0104.5, Predator UAV Basic Universal Metadata Set, 14 December, 2006
- SMPTE 335M-2001, Metadata Dictionary Structure
- SMPTE 336M-2001, Data Encoding Protocol Using Key-Length-Value
- SMPTE RP210.10-2007, SMPTE Metadata Dictionary Contents
- STDI-0002 The Compendium of Controlled Extensions (CD) for the National Imagery Transmission Format (NITFS), Appendix E, Airborne Support Data extensions (ASDE), Version 2.1, 16 November 2000 (Reformatted and republished: 1 August 2007)
- MISB Recommended Practice RP 102.4 Security Metadata Universal and Local Data Sets for Digital Motion Imagery,13 December 2007
- MISB Recommended Practice RP 0602.1 Annotated Universal Metadata Set, 13 June 2007
- MISB Recommended Practice RP 0603 Common Time Reference for Digital Motion Imagery Using Coordinated Universal Time (UTC), 10 August 2006
- MISB Recommended Practice RP 0604 Time Stamping Compressed Motion Imagery, 13 June 2007
- MISB Recommended Practice RP 0605.1 Inserting Time Code and Metadata in High Definition Uncompressed Video, 13 September 2007
- MISB Metadata Registry EG 0602 (Draft)
- ISO 8601: 2004 (E), Data Elements and Interchange Formats – Information Interchange – Representation of Dates and Times
- STANAG 4609 AIR (EDITION 1) – NATO DIGITAL MOTION IMAGERY STANDARD, 23 March 2005
- AEDP-8 (Edition 2), NATO Motion Imagery (MI) STANAG 4609 (Edition 2) Implementation Guide, June 2007
- MIL-STD-2500C, National Imagery Transmission Format (NITF) Version 2.1 for the National Imagery Transmission Format Standard, 01 May, 2006
- IETF RFC 0768 User Datagram Protocol, August 1980
- IETF RFC 0791 Internet Protocol (IPv4), September 1981
- MIL-STD-1777 Internet Protocol, 12 August 1983

3. IMPLEMENTATION CONVENTION REQUIREMENTS

This section defines the unique, specific content of the applicable standards identified for this IC. The identified standards apply in total for the IC, except where further specified herein. Where a standard references another standard, or set of standards, the specific order and content is defined in sequence. Where a standard identifies multiple options, this section identifies the exact content for implementation of the single, interoperable mode of operation. When both a United States (US) and North Atlantic Treaty Organization (NATO) document are mandatory, the difference in requirements between the two documents is described and the single implementation requirement identified, with rationale.

3.1 Imagery Definition and Compression

In order to improve the quality and interoperability of motion imagery being produced by UASs, as well as to reduce, where possible, the bandwidth required to transmit said imagery, each system **shall**

PRODUCE, at a minimum, MISM Level 3 but **shall** exceed MISM level 3 with respect to compression ratios (i.e., systems shall compress video less than 28/56:1).

Current systems such as Open System Remote Video Terminal (OSRVT) Block 1 will be considered legacy systems and be allowed to DECODE at their current level. New systems and future spirals of current systems (such as OSRVT Block 2) **shall** DECODE all MPEG-2 transport streams with MPEG-2 compressed data types (Standard Definition, Enhanced Definition, High Definition) up to and including MISM Level 9 and all H.264 compressed data types up to and including MISM Level 9. The tables for MISM Levels 3 and 9 are included in this document, but can also be found in MISP 4.4 on page 20.

Table 1. Motion Imagery System Matrix, Level 3

System Level	L3M	L3H
Common Description/ Intended Application	Standard Definition / Distribution	
System Attributes: Spatial Definition	Standard	
System Attributes: Temporal Definition	Standard	
System Attributes: Generation Resiliency	Low	
Applicable Standard (Note: Other Profiles / Practices may apply)	MPEG-2 MP@ML	H.264 MP@L3
Horizontal Resolution (Nominal)	720	720
Vertical Resolution (Nominal)	480i - 576i	480i - 576i
Bit Depth (bits) (Nominal)	8	8
Frame Rate (FPS)	24 - 30	24 - 30
Compression Ratio (Maximum)	28:1	56:1
Data Rate (Nominal)	6 Mb/s	3 Mb/s
Data Rate Range	3-10 Mb/s	1.5 -5 Mb/s

Note: This table is an excerpt the MISM 3 table in MISP 4.4. For the purposes of this document, digital 4:2:0 MPEG-2 compressed motion imagery meets the minimum requirement of MISM Level 3.

Table 2. Motion Imagery System Matrix, Level 9

System Level	L9M/H	
Common Description/ Intended Application	High Definition / Distribution	
System Attributes: Spatial Definition	High	
System Attributes: Temporal Definition	Medium – High	
System Attributes: Generation Resiliency	Low	
Applicable Standard (Note: Other Profiles / Practices may apply)	SMPTE 296M-2001, Progressive modes of SMPTE 274M, 295M MPEG-2 MP@HL	SMPTE 296M-2001, Progressive modes of SMPTE 274M, 295M H.264MP@L3.2(720) H.264 MP@L4.0 H.264 HP@L4.0
Horizontal Resolution (Nominal)	1280 – 1920	
Vertical Resolution (Nominal)	720p - 1080p	
Bit Depth (bits) (Nominal)	8	
Frame Rate (FPS)	24 – 60 (720p) 24 – 30 (1080p)	
Compression Ratio (Nominal)	45:1	80:1
Data Rate (Nominal)	19.4 Mb/s	10 Mb/s
Data Rate Range	10 - 44.7 Mb/s	5 - 20 Mb/s

Note: This table is an excerpt from the MISM 9 table in MISP 4.4.

MISM-L9 Motion Imagery System Matrix-Level 9 (MISM-L9) is defined as any HD format of MISM-L11/10 that is highly compressed to use end-user (final link) transport delivery, such as the ATV transport delivery system in the US. MISM-L9 may also include other transport layer delivery systems used by US

Treaty partners. Note that a lower data rate can be obtained for the same motion image quality using H.264 versus MPEG-2. H.264 L4.0 can be used for data rates up to 20 Mb/s. The H.264 High profile should be used for 10- and 12- bit motion imagery.

Note about bit depths: While multiple bit depths are allowed, higher bit depths are preferred. For example, if 12-bit, 10-bit and 8-bit implementations are allowed under the standard, 12-bit implementations are preferred.

3.2 User Datagram Protocol/ Internet Protocol (UDP/IP)

Interoperability for the transmission of motion imagery between the Air Vehicle and the Control Station terminal or the Air Vehicle and a Remote Video Terminal is defined as Level 2 (LOI 2) interoperability. To ensure "end to end" utility of the MI across the TCPED architecture, this implementation specifies the standards for the transport and network layers of the system solution. Effective transmission of MI across the UAS air, control and remote terminals is key to establishing SA.

IP Packetization - AV to LOI 2 Receiver

USIP IP data passed between AV to LOI 2 Receiver **shall** use standard Packetization per IETF RFC 791, including IP packet lengths appropriate to supporting a maximum Ethernet MTU of 1500.

UDP Packetization - AV to LOI 2 Receiver

USIP UDP data passed between an AV to LOI 2 Receiver **shall** use standard packetization per IETF RFC 768, including UDP datagram lengths consistent with meeting the length restriction on the IP packetization.

In-flight IP Address Updates

In support of UAS relief on station, each UAS **shall** provide for in-flight/in-mission update of the configuration of the addressing of the payload product streams by UAS operator action.

CDL Subnet Addressing

CDL Subnet Addressing – Minimum Address Quantity

Each IPv4 subnet used for CDL data communications **shall** have a minimum of two host IP addresses, plus the broadcast and network address for the subnet.

Multicast Application for Level 2 LOI

Multicast Address Application and Address Source

Level 2 LOI operations **shall** be supported by the UA transmitting packetized video payload digital streaming output using one public IPv4 Class D multicast per payload product data stream.

RVT receipt of Multicast Video

RVT and other Level 2 LOI direct payload receiving devices **shall** be capable of configuration to accept packetized video payload digital streaming outputs transmitted on IPv4 Class D multicast addresses over CDL data communications.

IP Disclosure

In order for Level 2 receivers to gain knowledge of what data streams are available in downlink, and what the addressing values for those streams are, all USIP compliant data providers **shall** provide disclosure of the IP addressing of the payload products.

3.3 Metadata for Situational Awareness

The following data elements are **mandated** to ensure that MI has the associated metadata required for the user to obtain SA (according to the definition in this document). These specific data elements are used to compute the location of the platform, sensor, and sensor point of interest, to include field of view and frame center location.

The SA data elements are traced through all of the relevant MI standards. At this time, Motion Imagery Standards Profile (MISP) 4.4 allows for the use of either of EG 0104.5 of EG 0601.1. It is, however, the intention of the Motion Imagery Standards Board to merge both EG 0104.5 and EG 0601.1 into a single document – RP 701. Until that such time, for the purposes of this document, only the Predator (MQ 1 B&C) program is permitted to use EG 0104.5. All other UAS programs **shall** use EG 0601.1. The following traces site specific paragraphs, page numbers, and other pertinent information in order to remove all ambiguity and provide a single implementation to enhance interoperability.

Table 3. EG 0601.1 DATA ELEMENT TRACE

Data Element Name	16-Byte Key & Specification Trace
Platform Heading Angle	**06 0E 2B 34 01 01 01 07 07 01 10 01 06 00 00 00**
	- MISPv4.4 pg. 14 calls out EG0601.1 - EG0601.1 Key 5, pg. 31 Table 7.5 may also be used - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 PLATFORM HEADING ANGLE identifies 06 0E 2B 34 01 01 01 07 07 01 10 01 06 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
Platform Pitch Angle	**06 0E 2B 34 01 01 01 07 07 01 10 01 05 00 00 00**
	- MISPv4.4 pg. 14 calls out EG0601.1 - EG0601.1 Key 6, pg. 32 Table 7.6 may also be used - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 PLATFORM PITCH ANGLE identifies 06 0E 2B 34 01 01 01 07 07 01 10 01 05 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
Platform Roll Angle	**06 0E 2B 34 01 01 01 07 07 01 10 01 04 00 00 00**
	- MISPv4.4 pg. 14 calls out EG0601.1 - EG0601.1 Key 7, pg. 33 Table 7.7 may also be used - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 PLATFORM ROLL ANGLE identifies 06 0E 2B 34 01 01 01 07 07 01 10 01 04 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
Platform	**06 0E 2B 34 01 01 01 01 01 01 20 01 00 00 00 00**
	- MISPv4.4 pg. 14 calls out EG0601.1 - EG0601.1 Key 10, pg. 36 Table 7.10 may also be used - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary)

Designation	- RP210.10 DEVICE DESIGNATION identifies 06 0E 2B 34 01 01 01 01 01 01 20 01 00 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV

Data Element Name	16-Byte Key & Specification Trace
Sensor Relative Elevation Angle	**06 0E 2B 34 01 01 01 01 0E 01 01 02 05 00 00 00**
	- MISPv4.4 pg. 14 calls out EG0601.1 - EG0601.1 Key 19, pg. 45 Table 7.19 may also be used - MISB Metadata dictionary SENSOR RELATIVE DEPRESSION ANGLE identifies 06 0E 2B 34 01 01 01 01 0E 01 01 02 05 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
UAS LDS Version Number	**06 0E 2B 34 01 01 01 01 0E 01 02 03 03 00 00 00**
	- MISPv4.4 pg. 14 calls out EG0601.1 - EG0601.1 Key 65, pg. 91 Table 7.65 may also be used - MISB Metadata dictionary UAS LDS VERSION NUMBER identifies 06 0E 2B 34 01 01 01 01 0E 01 02 03 03 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
Checksum	**06 0E 2B 34 04 01 01 01 0E 01 02 03 01 00 00 00**
	- MISPv4.4 pg. 14 calls out EG0601.1 - EG0601.1 Key 1, pg. 27 Table 7.1 may also be used - MISB Metadata dictionary CHECKSUM identifies 06 0E 2B 34 04 01 01 01 0E 01 02 03 01 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV

Table 4. EG 0104.5 DATA ELEMENT TRACE

Data Element Name	16-Byte Key & Specification Trace
	06 0E 2B 34 01 01 01 07 07 01 10 01 06 00 00 00
	- MISPv4.4 pg. 13 calls out EG0104.5 - EG0104.5 pg. 5 PLATFORM HEADING ANGLE calls out use of Section 4.1 on pg. 2 to begin

Data Element Name	16-Byte Key & Specification Trace
Platform Heading Angle	- SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 PLATFORM HEADING ANGLE gives 06 0E 2B 34 01 01 01 07 07 01 10 01 06 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
Platform Pitch Angle	**06 0E 2B 34 01 01 01 07 07 01 10 01 05 00 00 00**
	- MISPv4.4 pg. 13 calls out EG0104.5 - EG0104.5 pg. 5 PLATFORM PITCH ANGLE calls out use of Section 4.1 on pg. 2 to begin - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 PLATFORM PITCH ANGLE gives 06 0E 2B 34 01 01 01 07 07 01 10 01 05 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
Platform Roll Angle	**06 0E 2B 34 01 01 01 07 07 01 10 01 04 00 00 00**
	- MISPv4.4 pg. 13 calls out EG0104.5 - EG0104.5 pg. 6 PLATFORM ROLL ANGLE calls out use of Section 4.1 on pg. 2 to begin - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 PLATFORM ROLL ANGLE gives 06 0E 2B 34 01 01 01 07 07 01 10 01 04 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
Project ID	**06 0E 2B 34 01 01 01 01 01 01 20 01 00 00 00 00**
	- MISPv4.4 pg. 13 calls out EG0104.5 - EG0104.5 pg. 5 PROJECT ID calls out use of Section 4.1 on pg. 2 to begin - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 DEVICE DESIGNATION identifies 06 0E 2B 34 01 01 01 01 01 01 20 01 00 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV

Data Element Name	16-Byte Key & Specification Trace
Device Latitude	**06 0E 2B 34 01 01 01 03 07 01 02 01 02 04 02 00**
	Point/Latitude = Device Latitude - MISP 4.4 pg. 13 calls out EG0104.5 - EG0104.5 pg. 6 DEVICE LATITUDE calls out use of Section 4.1 on pg. 2 to begin implementation - SMPTE 335 Section 1 references RP210.10 (Metadata Dictionary) - RP210.10 DEVICE LATITUDE identifies 06 0E 2B 34 01 01 01 03 07 01 02 01 02 04 02 00 - SMPTE 336 pg. 14, Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
Device Longitude	**06 0E 2B 34 01 01 01 03 07 01 02 01 02 06 02 00**
	Point/Longitude = Device Longitude - MISPv4.4 pg. 13 calls out EG0104.5 - EG0104.5 pg. 6 DEVICE LONGITUDE calls out use of Section 4.1 on pg. 2 to begin implementation - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 DEVICE LONGITUDE identifies 06 0E 2B 34 01 01 01 03 07 01 02 01 02 06 02 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
Device Altitude	**06 0E 2B 34 01 01 01 01 07 01 02 01 02 02 00 00**
	Point/HAE = Device Altitude - MISPv4.4 pg. 13 calls out EG0104.5 - EG0104.5 pg. 6 DEVICE ALTITUDE calls out use of Section 4.1 on pg. 2 to begin implementation - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 DEVICE LONGITUDE identifies 06 0E 2B 34 01 01 01 01 07 01 02 01 02 02 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV

Data Element Name	16-Byte Key & Specification Trace
User Defined Time Stamp	**06 0E 2B 34 01 01 01 03 07 02 01 01 01 05 00 00**

	Time = User Defined Time Stamp
	Start = User Defined Time Stamp
	
	- MISPv4.4 pg. 13 calls out EG0104.5
	  - EG0104.5 pg. 5 USER DEFINED TIME STAMP calls out use of Section 4.1 on pg. 2 to begin
	
	- EG0104.5 calls out ISO 8601.2004.E
	
	- ISO 8601 pg. 7 = SCOPE (types of time)
	  - Use EXTENDED TIME format on pg. 19 in Section 4.1.2.2
	    - The complete format is on pg. 18 in Section 4.3.2
	
	- SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary)
	  - RP210.10 USER DEFINED TIME STAMP identifies 06 0E 2B 34 01 01 01 03 07 02 01 01 01 05 00 00
	
	- SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV

Angle to North	**06 0E 2B 34 01 01 01 01 07 01 01 10 01 02 00 00 00**

	Sensor/Azimuth = Angle to North
	
	- MISBv4.4 pg. 13 calls out EG0104.5
	  - EG0104.5 pg. 5 ANGLE TO NORTH calls out use of Section 4.1 on pg 2 to begin implementation
	
	- SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary)
	  - RP210.10 ANGLE TO NORTH identifies 06 0E 2B 34 01 01 01 01 07 01 10 01 02 00 00 00
	
	- SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV

Sensor FOV, Horizontal	**06 0E 2B 34 01 01 01 02 04 20 02 01 01 08 00 00**

	Sensor/fov = Sensor Field of View Horizontal
	
	- MISBv4.4 pg. 13 calls out EG0104.5
	  - EG0104.5 pg. 5 FIELD OF VIEW (HORIZONTAL) calls out use of Section 4.1 on pg 2 to begin
	
	- SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary)
	  - RP210.10 SENSOR HORIZONTAL FIELD OF VIEW
	      = 06 0E 2B 34 01 01 01 02 04 20 02 01 01 08 00 00
	
	- SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV

Data Element Name	16-Byte Key & Specification Trace
Sensor FOV, Vertical	**06 0E 2B 34 01 01 01 07 04 20 02 01 01 0A 01 00**
	Sensor/vfov = Sensor Field of View Vertical - MISBv4.4 pg. 13 calls out EG0104.5 - EG0104.5 pg. 5 FIELD OF VIEW (VERTICAL) calls out use of Section 4.1 on pg 2 to begin - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 SENSOR VERTICAL FIELD OF VIEW = 06 0E 2B 34 01 01 01 07 04 20 02 01 01 0A 01 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
Image Source Device	**06 0E 2B 34 01 01 01 01 04 20 01 02 01 01 00 00**
	Sensor/model = Image Source Device - MISPv4.4 pg. 13calls out EG0104.5 - EG0104.5 pg. 6 IMAGE SOURCE DEVICE calls out use of Section 4.1 on pg. 2 to begin - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 IMAGE SOURCE DEVICE identifies 06 0E 2B 34 01 01 01 01 04 20 01 02 01 01 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV
Slant Range	**06 0E 2B 34 01 01 01 01 07 01 08 01 01 00 00 00**
	Sensor/range = Slant Range - MISBv4.4 pg. 13 calls out EG0104.5 - EG0104.5 pg. 5 SLANT RANGE calls out use of Section 4.1 on pg 2 to begin implementation - SMPTE 335 Section 1 calls out RP210.10 (Metadata Dictionary) - RP210.10 SLANT RANGE identifies 06 0E 2B 34 01 01 01 01 07 01 08 01 01 00 00 00 - SMPTE 336 pg. 14 Universal Data Set Description (UDS) calls out use of Section 6.1 to encode to KLV

3.4 Emerging Standards

This section describes the expected work in progress to develop changes to the applicable standards documents or new standards that may pertain to this IC. The purpose is to inform the IC users for consideration in development of the UAS program TV-2.

STANAG 4609 AIR (EDITION 1) – NATO DIGITAL MOTION IMAGERY STANDARD, 23 March 2005 and the associated AEDP-8 (Edition 2), NATO Motion Imagery (MI) STANAG 4609 (Edition 2) Implementation Guide, June 2007 is ratified but appears in this section because it is not in the DoD Information Technology Standards and Profile Registry (DISR). This section identifies the differences in implementation detail between the STANAG 4609/AEDP 8 and the MISB standards.

- STANAG 4609 Annex C, STANDARD 0223 – Compressed High Definition Advanced Television (ATV) and Associated Motion Imagery Systems, pg 5 mandates that both sending and receiving systems must be able to decode, process and display all of the diverse sampling structures. The STANAG does not distinguish between system types for the Standard Definition applications. MISP 4.4 STANDARD 9723, pg 42 only covers receiving systems.

- STANAG 4609 Annex C, pg 3- STANDARD 0202 Standard Definition Digital Motion Imagery Sampling Structure goes beyond MISP 4.3, STANDARD 9702, pg 35 and adds Note 1: Once Motion Imagery has been originated in digital format or converted from legacy analog to standard digital formats, it must remain in its digital format. Dual standard legacy analog to standardized digital formats, it must remain in its digital format. Dual standard (525/30i/625/25i) analog display devices may be used as termination elements of an otherwise all-digital motion imagery system.

- AEDP 8 Edition 2, Annex A, pg A2 -Mandates that all relevant MI systems used by participating nations will be able to decode all compressed data types (Standard Definition, Enhanced Definition, High Definition) but each Nation may choose how to originate one, two or all data types. The compressed data type **shall** be specified for the level of definition provided by the sensor.

- AEDP 8, pg A-2 – Nations implementing STANAG 4609 **shall** be able to accept and decode Motion Imagery up to and including MISM Level 10 (high definition format). MISP 4.5 (which at the time this document was written is out for comment) will contain a mandate of MISM Level 9. The MISM, contained in both STANAG 4609 and MISP 4.4, provides user communities with an easy to use, common short-hand reference language to describe the fundamental technical capabilities of motion imagery systems and includes technical specifications and recommendations in terms efficiencies and incompatible implementations.

The following is an excerpt from MISP 4.4 and provides context on advances in imaging and display systems performance that impact the selection of standards and specification of implementation details.

> DoD/IC/NSG user comminutes have diverse mission requirements and will select diverse motion imagery systems, across a range of capabilities, to meet system performance objectives. This section outlines the desired end-state of DoD/IC/NSG motion imagery capabilities. Not all users will require a migration to the highest possible spatial and temporal resolution, but all users should be aware of the target end-objectives for motion imagery capabilities for the DoD/IC/NSG as described below:

- The fundamental direction for motion imagery systems is to move to common standards featuring all digital, progressive scan processing, and square pixels; moving to higher spatial, temporal, and spectral resolutions as technology becomes available.

- Standard definition, analogue interlace systems are considered the legacy initial state, where such analog interlace systems are formally considered to be obsolete systems and as such must not be replaced with any new analog systems. Within analog families, component processing (R:G:B, Y:R-Y:B-Y, Y:C) is always preferred over composite processing. (such as NTSC or PAL).

- Standard definition, digital interlace (Rec. 601-5, 4:2:2 component processing), using serial digital interfaces (SDI, SMPTE 259M/291M) is a logical and most economical upgrade from analogue interlace systems. However, the cost differential between standard definition digital interlace and enhanced definition digital progressive systems is minimal and decreasing, therefore a migration to enhanced definition is strongly advised.

- Enhanced definition, digital progressive (720 x 480 x 60p and 720 x 576 x 50p) can be considered to yield the best combination of improved spatial and temporal resolution capabilities at minimal increased costs as compared to today's broadcast quality digital interlace (Rec. 601-5) systems. However, 480p and 576p systems do not utilize square pixels and thus have insufficient horizontal pixels to properly deliver 16:9 aspect ratio imagery. Therefore, enhanced definition may be a suitable objective end-state for imagery systems that have no requirement to move to high definition spatial or temporal resolutions and do not require wider (16:9) aspect ratios.

- High Definition, progressive scan imagery (SMPTE 296M-2001) is a desired end-state for NATO motion imagery systems. 1280 x 720 x (50p) 60p is the target HD imaging format for all existing and currently planned motion imagery collection systems that will be fielded in the next five to ten years. 1020 x 1080 x (50p) 60p is anticipated to become the revised end-objective in approximately five years (when the technology becomes more mature). User communities that do not require high temporal resolution may consider use of 1020 x 1080 x 24p/25p/30p systems in special limited applications with controlled environments (such as studio production, training, etc.). The anticipated dynamic geo-political landscape and military battle space environment requires a complex trade space of maximal spatial and temporal resolution, thus 1280 x 720 x (50) 60p will remain the objective architecture end-goal.

4. CERTIFICATION

Certification of the MI system to the requirements of this IC **shall** be performed by the Joint Interoperability Test Command JITC). The applicable standards and additional specification contained in this IC constitute compliance criteria for testing. The JITC **shall** determine methods and metrics in association with the governing standards bodies.

5. NOTES

5.1 Summary

With the rapid growth and advances in technologies, it is necessary that in the design and development of new systems or significant updates to existing systems, that diligence toward emerging architectures, standards, and metadata be addressed for the enablement of data interoperability across the entire TCPED and Tasking, Posting, Processing and Using (TPPU) architecture. This will better enable users across the NSG to discover, access, use, and fully exploit the data from the sensors on these platforms.

5.2 Abbreviations and Acronyms

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Acronym	Definition
CONOPS	Concept of Operations
DoD/IC/NSG	Department of Defense/Intelligence Community/National System for Geospatial Intelligence
DCGS	Distributed Common Ground System
FMV	Full Motion Video
HD	High Definition
IC	Implementation Convention
JCA	Joint Capability Area
LOI	Level of Interoperability
MI	Motion Imagery
MISM	Motion Imagery System Matrix
MISP	Motion Imagery Standards Profile
MPEG	Moving Picture Experts Group
NATO	North Atlantic Treaty Organization
SA	Situational Awareness
STANAG	Standardization Agreement
TCPED	Tasking, Collection, Production, Exploitation and Dissemination
US	United States
UAS	Unmanned Airborne System